Arab Academy for Science & Technology & Maritime Transport
(AASTMT – Cairo Branch)
College of Engineering & technology
Electronics & Communication Engineering Department

Course : Solid State Electronics
Course Code : EC210

Sheet #9

TextBook
'Principles of Electronic Materials and Devices', Third Edition, S.O. Kasap © McGraw-Hill, 2006

Constants:

$\varepsilon_o = 8.85\times10^{-12}\,\mathrm{Fm^{-1}}$

Charge of electron $(q) = 1.6\times10^{-19}\,\mathrm{C}$

Mass of electron $(m_e) = 9.1\times10^{-31}\,\mathrm{kg}$

Plank's Constant $(h) = 6.63\times10^{-34}\,\mathrm{Js}$

Boltzmann's Constant (k) = $1.38\times10^{-23}\,\mathrm{JK^{-1}} = 8.617\times10^{-5}\,\mathrm{eVK^{-1}}$

Solve the following problems

[1] Plot the Fermi-Dirac distribution if Fermi-Level is located at 0.56 eV for T=0K,1000K.

[2] Plot the Fermi-Dirac distribution for intrinsic silicon at T=1000K if $E-E_f = \pm0.3$, $E-E_f = \pm0.6$.

[3] For n-type silicon with E_{Fermi} below the conduction band with 0.2eV at T=200K.
Use both the Fermi-Dirac and the Maxwell-Boltzmann distribution to calculate the probability of finding an electron at Ec (bottom of conduction band).

[4] Given the effective density of states for conduction band and for valence band to be respectively, $2.81\text{x}10^{19}$ $\mathrm{cm^{-3}}$ and $1.16\text{x}10^{19}$ $\mathrm{cm^{-3}}$, calculate the intrinsic concentration and the intrinsic resistivity of Si. The electron and hole drift mobilities are given at room temperature as 1350 and 450 $\mathrm{cm^2V^{-1}s^{-1}}$.

[5] For silicon at T=300K, given that the value of $N_c = 2.8\text{x}10^{19}$ $\mathrm{cm^{-3}}$ and $N_v = 1.04\text{x}10^{19}$ $\mathrm{cm^{-3}}$, find:
a) The electron concentration for an n-type doped semiconductor if E_F is located at 146 meV below E_C.
b) The hole concentration for a p-type doped semiconductor if E_F is located at 0.31eV above E_V.